Proposing a socio-psychological model for adopting green building technologies: A case study from Iran

Melika Rajaee[a], Seyed Mahmoud Hoseini[b],[*], Iraj Malekmohammadi[a]

[a] Department of Extension and Education, College of Agriculture and Natural Resources, Science and Research Branch, Islamic Azad University, Tehran, Iran
[b] Department of Extension and Education, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran

ABSTRACT

Energy crisis, environmental degradation, urbanization, industrialization, and climate change pose serious challenges to sustainable development. The expansion of green buildings (GBs) is regarded both as an effective method for energy consumption and an important strategy in the construction industry. However, in Iran due to lack of knowledge and awareness, uncertainty, and permission-related problems, GBs have failed to attract the attention of developers and purchasers. Therefore, identifying the factors that influence the adoption of GBs in the Iranian setting is still unknown and needs a critical examination. To fill this gap, the present study expands the Technology Acceptance Model (TAM) by adding five factors (including social influence, subjective knowledge, environmental attitude, perceived cost, and trust in responsible organizations) and examining their impacts on building experts' adoption of GBTs. The sample of the study included 301 GB experts in Tehran City, Iran. Sixteen hypotheses were proposed and tested applying the partial least squares path modeling (PLS) approach. The results indicate subjective knowledge was only a good predictor of intention and did not exercise an influence on attitude and perceived usefulness. Social trust, attitude, and perceived cost also predicted intention. Perceived usefulness was a good predictor of both attitude and intention. Perceived ease of use was a good predictor of perceived usefulness and attitude. The results of this study provide key insights into promoting GBTs, as an effective pro-environmental behavior, in developing countries.

1. Introduction

In the current modern and technology-based world, there is a common agreement among scholars that green building (GB) is a necessary practical approach to implementing sustainability and green construction (Sev, 2009; Son, Kim, Chong, & Chou, 2011). Buildings, in particular, residential buildings are responsible for more than 30% of the world's total energy. Buildings play an important role in causing greenhouse gas (GHG) emissions, environmental degradation, energy consumption, resource use, and air pollution (O'Neill & Gibbs, 2018). These facts highlight a pressing need for energy management, waste minimization, resource management, and sustainability development. Accordingly, the growing interest in GB has considerably contributed to promoting the sustainability performance of buildings in the construction industry. GB is part of the social movement in the field of environmental sustainability, aiming to decrease GHG emissions and minimize environmental problems (World GBC, 2013; Zhao, He, Johnson, & Mou, 2015; Hoffman & Henn, 2008).

Various definitions have been proposed for GB. For example, United States Environmental Protection Agency (2016) defines GB, "the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's lifecycle". Portnov et al. (2018, p. 280) also observe that GB is "the practice of creating and using more resource-efficient models of planning, design, construction, renovation, operation, maintenance, and demolition of buildings". Overall, these definitions indicate that GB can help develop a suitable and healthy living environment for human beings (Soleri, 1969). Research has vividly illustrated benefits of promoting GBs, including minimizing "the negative impacts of buildings on resource consumption, the environment, and human health" (Portnov et al., 2018, p. 280), offering environmental, socio-economic benefits to the construction industry, and providing "a sustainable development opportunity as it can minimize the pollutants, renew natural resources" through sustainable buildings.

Darko et al. maintain that GBs refer to buildings that use eco-friendly building materials and products such as recyclable wood, smart lighting systems, recycled roofing, energy-efficient appliances, etc. The German government has recently launched initiatives to promote

sustainable buildings across the country, defining GB as "reducing land use, minimising energy consumption in construction and operation of the building, meeting the requirements of future generations by ensuring the longest possible service life and relying on regenerative raw materials for building purposes" (BVBS 2010, 15).

Research has also reported that GBs can potentially maximize human health (Wang et al., 2018), improve efficiency and productivity, reduce operational costs, and help protect the natural environment. GBs can be employed in designing residential, commercial, industrial, and educational buildings. In brief, GBs is an efficient way to create a balance "between environmental, economic, and social objectives". Interestingly, on the one hand, global environmental protection initiatives and natural ecology programs recognize GB as an essential part of sustainable development. On the other hand, many countries worldwide, including developed and developing countries, are designing GB-focused programs and issuing GB certificates (Mao, Lu, & Li, 2009; Shi, 2014). Importantly, as Chan, Darko, and Ameyaw, 2017, p. 970) point out, factors like "mandatory environmental regulations by the government, government and non-governmental organization's requirements (e.g., green label scheme), and establishment of standards (e.g., green specification)" have played key roles in accelerating the adoption of GB in building projects.

As a result of the growing awareness of GBs, scholars now direct their attention to green building technologies, (GBTs), a concept that calls attention to the enhancement of building sustainability. GBTs are green technologies (e.g., high-efficiency heating systems, solar technology, water/energy efficient technologies, energy efficient appliances, etc.) adapted to enhance performance and effectiveness of buildings (Ahmad, Thaheem, & Anwar, 2016). Zhang, Platten, and Shen, (2011) point out that GBTs substantially help achieve sustainable development. Past research has also raised our awareness that the utilization of GBTs in building projects provides "a cost-effective option for developers, decision makers, and policymakers aiming to attain long-term building environmental, economic, and social performance improvements". In line with Chan et al. (2017), p. 2) argue convincingly that, "adopting GBTs provides a wide variety of economic, social, and environmental benefits and, along with the growing awareness of climate change, these benefits play a huge role in pushing for the adoption and development of GBTs".

Despite the mentioned benefits, several barriers such as lack of awareness and market demand make the adoption of GBTs difficult. Purchasers usually consider the price as well location of a GB as important criteria. Therefore, without the market demand, developers and planners cannot promote GBTs (Liu et al., 2018; Persson & Grönkvist, 2015).

Various studies have investigated factors influencing the adoption of GBTs, highlighting the importance of psychological and social factors in the process to adopt these technologies (Cole, Brown, & McKay, 2010; Hoffman & Henn, 2008; Zuo & Zhao, 2014). According to these studies, today the problems facing GBs are more psychological and social than technical and economic ones and are related to the decisions made by the residents (Zhao et al., 2015; Zuo & Zhao, 2014).

As noted above, there is a lack of knowledge about what constitutes the adoption of GBTS and this is a barrier to encourage community members to use GBs effectively. This problem is more serious in developing countries like Iran, which faces severe environmental and climate problems, including water and energy sources scarcity, environmental pollution. Policy makers have also failed to seek an operational solution to these problems. Therefore, there is a crucial need to examine GBs, their constituent elements (i.e., GBTs), and the social and psychological factors affecting GBTs in the Iranian context. Since past research has failed to examine factors influencing the adoption of GBTs in Iran, the present study attempts to fill the gap and identify the social and psychological factors affecting GBTs. Using the extended TAM model, this case study examines GB experts' perceptions in the Iranian context.

The TAM model was first introduced by Davis, Bagozzi, and Warshaw, (1989) to explain how individuals come to accept and use a particular technology. This model is based on rational relationships between belief, attitude, intention, and behavior. In the TAM model, people's belief in the usefulness and ease of using a technology influences their attitudes towards technology, and this attitude also influences the intention to use technology and its ultimate use. Perceived usefulness and ease of use may also be influenced by external factors such as training and supporting the application. When the study of the behavior is not possible, the study of intention to accept technology is only carried out (Davis et al., 1989; Gefen, Karahanna, & Straub, 2003).

There are three main reasons for the popularity of the TAM model. First, it explains the acceptance of a variety of technologies in diverse contexts. Second, it has a robust theoretical literature in determining the appropriate scale. Third, powerful empirical studies have been done to increase the explanatory power of this model (Yousafzai, Foxall, & Pallister, 2010).

Since the use of technology in GBs is in its very early stages in developing countries such as Iran, this study employs the TAM model as a theoretical framework to investigate GBTs. This theoretical framework is not only capable of explaining users' adoption of innovation and technologies, but also powerful in "explaining and predicting users' acceptance of technological innovations, or new products" (Liu et al., 2018, p. 153). In fact, the model is based upon the assumption that if city residents understand that GBTs are useful and easy to use, they will have a higher intention to accept these technologies. Research demonstrates that factors including residents' knowledge, social trust in responsible organizations, environmental perception, perceived cost, and social influence might adopt GBTs.

Residents' knowledge about GBs and their benefits is important in stimulating motivation and intention to adopt. People with higher knowledge of GBTs tend more to adopt these technologies (Liu et al., 2018). On the other hand, social trust plays an important role in the decision-making process of GBs adoption. Currently, there is no sufficient knowledge about these technologies since GBs still have not gained much popularity. Therefore, in such situations, people use trust as a risk reduction strategy (Earle & Cvetkovich, 1995; Liu et al., 2018).

Social trust in responsible organizations promoting GBTs can reduce the complexity involved in the general decision to adopt GBTs. Social trust in responsible organizations is also one of the main tools to reduce the uncertainty and perceived risk of customers. It can create a sense of safety to purchase products. Therefore, social trust can play an important role in the formation of attitudes of residents and their intention to use GBTs (Liu et al., 2018; Suh & Han, 2002).

Another important factor that plays an important role in the decision to accept GBs is the environmental attitude. GBs are a kind of environmental protection products, helping accept GBTs. Therefore, a general environmental perspective can result in a general intention to accept GBs (Liu et al., 2018).

Research has revealed that social influence is significant at the early stages of adoption of innovation (Swinerd & McNaught, 2015), as it affects the perceived ease of use and develops a desirable attitude (Choi, Lee, Sajjad, & Lee, 2014). Accordingly, since the adoption of GBTs is in the initial stages of development in Iran, this factor is also added to the model.

Considering the limited research on the psychological factors affecting the adoption of GBTs, this study can fill this gap by providing a better understanding of the cognitive dimensions of GBTs adoption. Exploring these factors in a developing country like Iran can be a driving force to motivate the general public and policymakers to move towards GBs, either in design, adoption, or implementation phases.

Finally, by adding the five factors mentioned above to the TAM model, we aim to increase the power of this model to predict the adoption of GBTs. To the best of our knowledge, there is no research into this issue in the Iranian context. Therefore, the results of this study can provide insights into the movement towards sustainable

development in Iran.

The remaining section of this study is as follows. The second part deals with the related literature review, discussing the TAM framework and the acceptance behavior of GBTs. The third part relates to the research methodology, describing data collection, reliability and validity. The fourth part presents the results. The final section is devoted to discussion, implications, and future research.

2. Literature review and theoretical framework

2.1. Theoretical framework

A variety of models have been developed and proposed to explain acceptance of a new technology. One famous approach known as the technology acceptance model (TAM), has been generated in depth circulation of research exploring consumers' usage intentions (Davis, 1989). TAM was adapted through the Theory of Reasoned Action (TRA), which refers to an individual's intentional behavior. It is pointed out that, TAM is "a predictive and explanatory tool for testing user acceptance of technologies with the aim of understanding the impact of external factors on internal beliefs, attitudes, and intentions" (Pan, Jacobs, Tan, & Askool, 2018, p. 45). Moreover, TAM has become widely accepted as being a robust model to be utilized. The original notion of this theory is the fact that external variables, including personal values and beliefs, lead to real actions (Cheung & Vogel, 2013; Keat & Mohan, 2004; Kim, Lee, Mun, & Johnson, 2017; Hung, Ku, & Chang, 2003). Indeed, TAM established to be a parsimonious model with the high explanatory power of the variance in users' acceptance related to green building adoption and usage throughout a variety of contexts (Park, Roman, Lee, & Chung, 2009). Therefore, this study uses TAM as a theoretical base. On the other hand, the concept of behavioral intention is derived from the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1975). This theory explains that external variables such as personal values, beliefs, and norms play a prominent role function in individual's aim to perform a behavior (Cheung & Vogel, 2013; Kim et al., 2017; Legris, Ingham, & Collerette, 2003).

Numerous researchers and organizations have revealed that GBTs adoption provides many environmental, economic, and social benefits, such as increased water efficiency, improved productivity, enhanced human health and wellbeing, improved indoor environmental quality, and better property value.

For green building technology planners, a more practical question is: what social and psychological increase community perceptions that green building technology is useful and safe? This study draws on the theoretical domains of the TAM, Subjective knowledge, Social trust, Attitude, and Environmental Attitude toward green building technology, Perceived usefulness, Perceived ease of use, Social influence and Perceived cost to develop an integrated framework that incorporates the driving influences of these variables on acceptance of GB technologies.

The study allows us to draw a broader and more holistic picture of the drivers of consumer acceptance of GB technologies compared to previous research. The knowledge this study generates will be useful to GB technology planners and buyers. A more thorough understanding of the impact of consumers' beliefs about GB technologies on their acceptance of the technologies could help practitioners learn more about how to entice consumers to buy and build GBs more frequently.

The structures of this developed model include subjective knowledge about green buildings, social trust in responsible organizations for implementing related measures, understanding the usefulness of green building technologies, ease of use of green building technologies, attitudes about green building, public attitudes about environmental issues, perceived cost, social influence and the intention adopt green building technologies. Fig. 1 presents the theoretical research framework developed for this study (Fig. 2).

2.2. Research hypotheses

2.2.1. Subjective knowledge

Knowledge is a very important concept in behavioral studies. A person's knowledge of a subject significantly affects his/her decisions and behavior about the subject. Several studies have pointed to the positive influence of knowledge on intention to use pro-environmental products and the emergence of environmental conservation behaviors. Particularly, the influence of knowledge is frequently reported in studies examining the efficient use of energy resources, and renewable energy resources (Hu, Parsa, & Self, 2010; Liu et al., 2018; Zografakis et al., 2010).

There are two main categories of knowledge. The first category is objective knowledge representing the extent to which an individual has the actual level of knowledge about a particular subject. The second category is subjective knowledge representing an individual's perceived or self-reported knowledge about a specific subject (2009, Park, Lee, & Cheong, 2008). It is argued subjective knowledge can more effectively predict environmental behaviors than objective knowledge. Also, there is a consensus that measuring objective knowledge is complex. This study examines subjective knowledge about GBTs (Liu et al., 2018). Knowledge about the benefits and usefulness of a particular technology is often related to the perceived value of that technology (Wang & Hazen, 2016). The following hypotheses are thus suggested:

H1. Subjective knowledge about GBTs has a positive effect on intention to use.

H2. Subjective knowledge about GBTs has a positive effect on perceived usefulness.

H3. Subjective knowledge about GBTs has a positive effect on attitude.

2.2.2. Social trust

The concept of trust has attracted more attention in social research. Rousseau, Sitkin, Burt, and Camerer, (1998) defined trust as "a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behavior of another" (p. 395). Siegrist, Cvetkovich, and Roth, (2000) also defined social trust as "the willingness to rely on those who have the responsibility for making decisions and taking actions related to the management of technology, the environment, medicine, or other realms of public health and safety" (p. 354). In the context of the present study, social trust can be considered as an important factor predicting the behavioral acceptance of technology (Huijts, Molin, & van Wee, 2014; Liu et al., 2018; Siegrist, 2000) positively.

Research suggests that social trust plays an important role in determining perceived usefulness. When users put their reliance on responsible organizations for GBTs, they probably admire the quality and usefulness of relevant technologies (Liu et al., 2018). Therefore, the following hypotheses are developed:

H4. Social trust in organizations responsible for GBTs has a positive effect on intention to use.

H5. Social trust in organizations responsible for GB has a positive effect on perceived usefulness.

2.2.3. Attitude

Attitude is a psychological construct dealing with a desirable or undesirable matter. It is a sustainable assessment of an issue. According to the TAM model, attitude towards technology has a positive effect on intention to use it (Davis et al., 1989; Gefen et al., 2003; Liu, Hong, & Liu, 2016). Therefore, the following hypothesis is presented:

H6. Attitudes towards GBTs have a positive effect on intention to use.
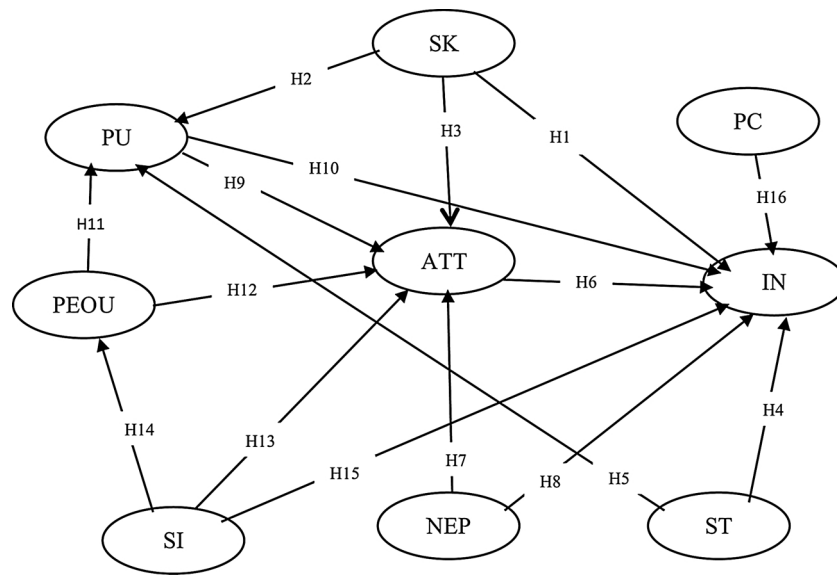
Fig. 1. Theoretical framework. Note: PC: Perceived Cost; SK: Subjective knowledge; ST: Social trust; PU: Perceived usefulness; ATT: Attitude; NEP: New Ecological Paradigm; IN: Intention; SI: Social influence.

2.2.4. Environmental attitude

Empirical research emphasizes the importance of environmental awareness and attitudes toward the adoption of GBTs (Liu et al., 2018; Zuo & Zhao, 2014). Social activities promoting GBs play a key role in raising public awareness of environment-related problems and helping individuals develop positive attitudes towards GBs and GBTs (Liu et al., 2018). Consistent with Stern's value belief norm (VBN) theory, the general attitude towards the environment has positive effects on intention and behavior of adopting GBTs. The VBN theory explains social movements supporting GBs a social-ecological movement. Focusing on ethical values and norms, this theory suggests that environmental norms, beliefs and values shape environmental protection and environmental conservation behaviors (Stern, 2000).

The New Ecological Paradigm (NEP) scale is a common measure of

environmental attitudes used to measure public beliefs regarding the relationship between man and environment. This scale measures three aspects of individuals' attitudes towards the environment, including the balance of nature, limits to growth, and human domination over nature (Dunlap & van Liere, 1978). The scale was then expanded to include five dimensions (Hawcroft & Milfont, 2010).

Previous studies highlighted the positive relationship between environmental attitude measured by the NEP indicator and the intention to adopt GBTs technologies. It is reasoned that individuals with positive attitudes towards environment develop more ability to accept risks and uncertainties arising from the decision to adopt GBTs (Deuble & de Dear, 2012; Liu et al., 2018). The positive relationship between environmental attitudes measured by NEP and environmental conservation behaviors has also been documented (Dunlap, Van Liere, Mertig, &

Fig. 2. Structural model: Note: PC: Perceived Cost; SK: Subjective knowledge; ST: Social trust; PU: Perceived usefulness; ATT: Attitude; NEP: New Ecological Paradigm; IN: Intention; SI: Social influence.
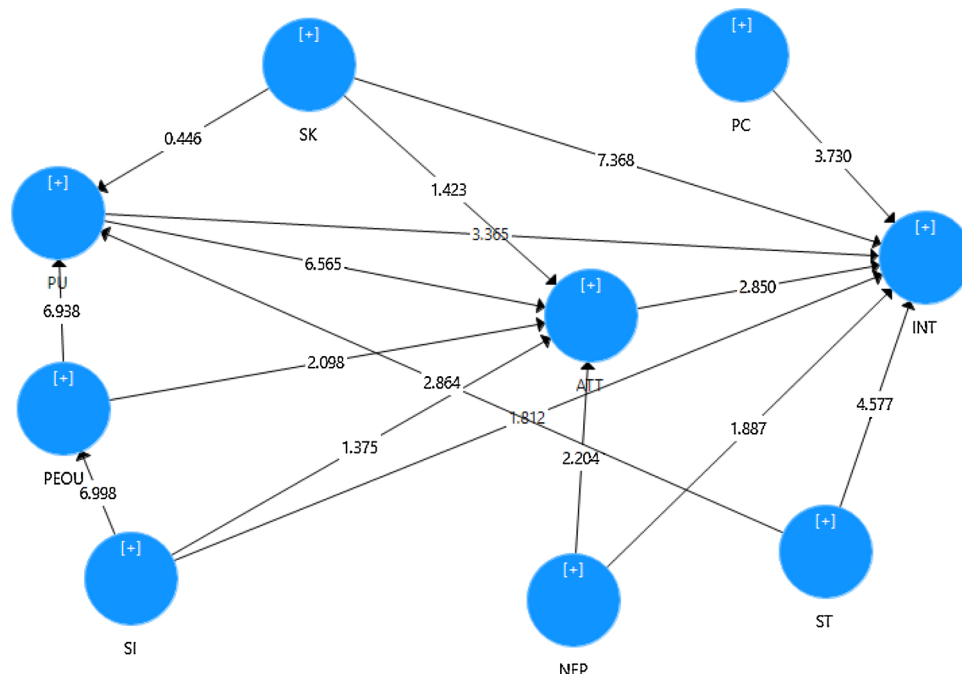
Jones, 2000; Kang, Stein, Heo, & Lee, 2012; López-Mosquera & Sánchez, 2012; Tsai & Tsai, 2008). On the other hand, previous studies have shown that general attitudes can form the basis of particular attitudes. Hence, it is revealed that the general attitude towards the environment has a direct influence on attitudes towards GBs (Dascher, Kang, & Hustvedt, 2014). Therefore, considering the above discussion, the following hypotheses are proposed:

H7. The environmental attitude surveyed by the NEP tool has a positive effect on the attitude towards GBTs.

H8. The environmental attitude surveyed by the NEP tool has a positive effect on the intention to use GBTs.

2.2.5. Perceived usefulness

Perceived usefulness (PU) is defined as the degree to which a person believes that using a particular system improves his/her performance in achieving the set goals (Davis et al., 1989). According to Davis (1989), p. 320), PU is "the degree to which a person believes that using a particular system would enhance his or her job performance". Although PU first defined regarding job performance in an organization, this concept is often linked to the individual's subjective evaluation of a particular technology in a specific context. In general, PU is defined as the advantage of new technology which has a significant positive effect on the attitude and intention to adopt (Venkatesh Thong, & Xu, 2012; Gefen et al., 2003). It is a predictor of behavioral intention and the actual use of technology by the individual (Davis et al., 1989).

Extending it to GBTs, PU is defined as the users' perceptions of the capabilities of technologies for environmental protection, energy management, cost savings, and building maintenance. PU is reported to be a strong and positive predictor of attitudes towards technology and the intention to use technology. According to the discussion, the following hypotheses are put forward:

H9. Perceived usefulness of GBTs has a positive effect on individual attitudes toward GBT.

H10. Perceived usefulness of GBTs has a positive effect on the intention to use GBT.

2.2.6. Perceived ease of use

Perceived ease of use (PEOU) is defined as "the degree to which a person believes that using a particular system would be free from effort". According to Venkatesh (2000), PEOU is influenced by experience and beliefs. PEOU, as an exogenous variable, exerts an indirect influence on behavior and intention through PU. The causal relationship between PU and PEOU has been confirmed in previous studies (e.g., Chung, Park, Wang, Fulk, & McLaughlin, 2010; Dasgupta, Granger, & McGarry, 2002; Park, 2010).

Previous research has acknowledged the significant impact between PU and the use of technology. Research has also shown the relationship between PEOU and actual use or behavioral intention (BI). Some scholars critiqued the direct influence of PEOU on actual usage or BI (e.g., Dasgupta et al., 2002; Davis, 1989; Karahanna & Straub, 1999).

Pan and Jordan-Marsh (2010) assumed that ease of use could be considered both as an endogenous and an exogenous variable in the TAM model. This is the most prominent construct of the TAM model (Amin, Rezaei, & Abolghasemi, 2014). Research shows that ease of use is a key determinant of predicting technology acceptance (Agarwal & Karahanna, 2000; Shen & Chiou, 2010).

Perceived ease of use is associated with past experiences of people (Sun, Tai, & Tsai, 2010). Recent research findings show that perceived ease of use does not directly affect the intention to accept, but influences it through perceived usefulness and attitudes towards intention (Halilovic & Cicic, 2015; Alaşehir, Sezgin, & Özkan, 2013; Saghafi, Moghaddam, & Aslani, 2017; Amin et al., 2014; Pai & Huang, 2011). Therefore, the following hypotheses are put forward:

H11. Perceived ease of use of GBTs has a positive effect on perceived usefulness.

H12. The perceived ease of use of GBTs has a positive effect on the individual's attitude toward GBT.

2.2.7. Social influence

Venkatesh and Davis (2000) modified the TAM model using social influence processes to predict the users' intention to use new technologies (Ajzen & Fishbein, 1975; Venkatesh, Morris, Davis, & Davis, 2003). Social influence is the process by which other people influence a person's perceptions, emotions, and opinions as a result of interactions. Subjective norms are influenced by the normative expectations of individuals in a reference group and the person's willingness to meet those expectations. Social influence suggests that an individual's acceptance of behaviour is affected by others (Kelman, 1958).

It is often observed that people perform an action or accept a specific technology, even when they are not desirable to them. Research has shown that social influence is significant at the early stages of adoption of innovation (Swinerd & McNaught, 2015) as it affects the perceived ease of use and develops a desirable attitude (Choi et al., 2014). A large body of research has shown the significant effect of social influence on behavioral intention (e.g., Al-Shafi & Weerakkody, 2010; Birch & Irvine, 2009). Therefore, according to the above discussion, the following hypotheses are developed:

H13. Social influence has a significant effect on the attitude of using GBTs.

H14. Social influence has a significant effect on the perceived ease of GBTs use.

H15. Social influence has a significant impact on the intention of using GBTs.

2.2.8. Perceived cost

One of the most common assumptions in the prediction of individuals' acceptance of new technologies, or its related costs, is to maximize value based on the classical economics method (Lichtenstein, Ridgway, & Netemeyer, 1993).

The extended TAM model includes perceived cost which is the cost involved in technology's value for the adopter. It indeed entails that the value of technology should be more than its financial cost for an individual to accept it. (Gefen et al., 2003; Venkatesh et al., 2012). Studies have shown that perceived cost has an inverse relationship with the intention to adopt technology (e.g., Kuo & Yen, 2009). Thus, according to the above discussion, the following hypotheses is developed:

H16: The perceived cost of GBTs affects intention to use.

3. Methodology

3.1. Data collection

This study was conducted in Tehran, the capital of Iran. There were two main reasons for choosing this city. First, Tehran's urban management has faced serious, though threatening and unresolved problems, including population growth (around 17 million people) and major environmental problems such as pollution of air, water, and soil, traffic, noise pollution, slums, municipal solid waste, resource consumption, visual pollution, etc. Although Tehran municipality and the Environmental Management Association made some efforts to develop GB plans to reduce the problems, because of lack of strategic planning as well as lack of government budget and support, these efforts soon failed (Tehran urban planning, 2018). Second, since Tehran is the center of political power in the country, residents can easily gain access to a variety of economic, political, cultural, and educational facilities compared to other cities in the country. Accordingly, it seems necessary

Table 1
Measurement model.

Construct	Item	Loading	CR[a]	AVE[b]	Alpha
SK	sk1	0/817	0/942	0/803	0/917
	sk2	0/939			
	sk3	0/925			
	sk4	0/897			
ST	st1	0/794	0/916	0/786	0/864
	st2	0/943			
	st3	0/916			
SI	si1	0/835	0/892	0/733	0/819
	si2	0/821			
	si3	0/910			
PC	PC1	0/915	0/956	0/879	0/931
	PC2	0/958			
	PC3	0/939			
NEP	NEP1	0/824	0/924	0/671	0/904
	NEP2	0/805			
	NEP3	0/843			
	NEP4	0/803			
	NEP5	0/799			
	NEP6	0/838			
ATT	AT1	0/898	0/922	0/798	0/874
	AT2	0/874			
	AT3	0/908			
PU	PU1	0/722	0/853	0/593	0/770
	PU2	0/770			
	PU3	0/828			
	PU4	0/757			
PEOU	PEOU3	0/814	0/890	0/730	0/814
	POUE1	0/865			
	POUE2	0/884			
INT	IN1	0/774	0/889	0/728	0/810
	IN2	0/865			
	IN3	0/915			

Notes: [a]composite reliability (CR) = (square of the summation of the factor loadings)/{(square of the summation of the factor loadings) + (square of the summation of the error variances)}; [b]Average variance extracted (AVE) = (summation of the square of the factor loadings)/{(summation of the square of the factor loadings) + (summation of the error variances)}; PC: Perceived Cost; SK: Subjective knowledge; ST: Social trust; PU: Perceived usefulness; ATT: Attitude; NEP: New Ecological Paradigm; IN: Intention; SI: Social influence.

to examine technologies adopted in GBs. The population of the study included green space experts working in Tehran province (who were 1080 experts in 2017). It is noteworthy that the Environmental Management Association of Tehran encouraged the GB experts to adopt GBTs using Telegram building campaign in 2017 (Tehran urban planning, 2018). This study is then conducted to examine the GB experts' perceptions and desires to accept GBTs. Using a stratified random sampling method, the participants were sampled according to Cochran's formula so that to collect 350 questionnaires from the mentioned sample.

To this end, three interviewers who were familiar with the present research project referred to the mentioned companies (from January to February 2018) and provided explanations about the purpose of the project, GBs, and GBTs. The participants were then asked to complete the questionnaires carefully. Finally, 301 questionnaires were used by the researchers.

3.2. Questionnaire development

There were nine primary variables in this study, including Subjective knowledge, Social trust in responsible organizations, Social influence, Perceived cost, Environmental attitudes, attitudes towards intention to use GBTs, Perceived usefulness, Perceived ease of use and Intention to use. A Five-point Likert-scale ranging from "1" (strongly disagree) to "5" (strongly agree) was used to measure the existing variables.

Subjective knowledge: To examine this construct, four questions were

selected based on the scales provided by Katsuya (2001) and Reinecke Flynn and Goldsmith (1999). *Social trust in responsible organizations:* To examine this construct, three main questions were selected based on the Chow and Chan's (2008) study. *Social influence:* For this section, three main questions were selected based on Suki & Suki's, study (2017) and Hsu & Lin,'s study (2008). *Perceived cost*: For this section, three main questions were selected based on the studies of Chen and Tsai (2017) and Cheung and Vogel (2013). Environmental attitudes: In this section, six main questions were selected based on Arcury and Christianson's (1990) study and Dunlap et al.'s (2000) study. *Attitude:* To measure attitudes towards intention to use GBTs, three questions were selected based on studies of Liu et al. (2018); Kim et al. (2017), and Chang, Hung, Cheng, and Wu, (2015), Chang, Hung, & Lin, 2015. *Perceived usefulness*: Considering the various psychological, environmental, and economic benefits of using GBTs, (Allen et al., 2015; Liu et al., 2018), four main questions were considered for perceived usefulness. *Perceived ease of use*: For this section, three main questions were selected based on Wu and Zhang (2014) and Chang (2010). *Intention to use.*: For this section, three main questions were selected based on the studies of Gefen et al. (2003) and Davis (1989) (3 Items). (For more information, see appendix A).

4. Data analysis and results

PLS-SEM was performed to investigate the data using SmartPLS version 3.2.6 (Ringle, Wende, & Becker, 2015).The statistical aim of PLS-SEM is to increase the explained variance of the endogenous latent constructs (Hair, Ringle, & Sarstedt, 2011).The common approach is to provide results in two phases (Chin, 2010).; first is the emphasis on the reliability and validity of measures used, and, the next stage entails the structural model diagnosis.

4.1. Measurement model

Verifying the adequacy of the data is vital before factor analysis. The Kaiser–Meyer–Olkin measure of sampling adequacy (KMO) index and Bartlett's test of Sphericity were both used to determine the appropriateness of sample adequacy. According to obtained results, KMO (0.818) was significantly above the threshold value of 0.7, while the Bartlett test of Sphericity (x^2 = 8543.892; df = 496, p = 0.000) was significant. Finally, the results confirmed that the implemented dataset in this study was suitable for exploratory factor analysis procedure. The measurement model was tested to assess the internal consistency reliability, convergent validity (CV) and discriminant validity (DV) of the constructs used in this study.

Internal consistency reliability measures the degree to which the items are a measure of the latent constructs (Hair, Sarstedt, Hopkins, & Kuppelwieser, 2014). Composite reliability was assessed as a measure of internal consistency (Hair, Hult, Ringle, & Sarstedt, 2017). As shown in Table 1, the values of Cronbach's α and composite reliability for all the constructs are higher than the suggested value of 0.7, indicating evidence of internal consistency of measures. Next, convergent validity, which refers to how closely related a set of multiple items measuring a similar conceptual construct may be, was assessed by examining the factor loadings and average variance extracted (AVE). Given that the loadings were more excellent than 0.7 and the AVE of all constructs was higher than 0.5, convergent validity was therefore established (see Table 1).

Tables 2 and 3 show the discriminant validity of research constructs. According to Table 2, diagonals (numbers in bold) represent the AVE, whereas the other entries represent the squared correlations. The cut-off values in the matrix are the correlations between the latent constructs that are less than

AVEs values. Also, a comparison of the loadings across the columns in the above matrix (loadings and cross-loadings of items) implies that an indicator's loadings on its construct are in all cases higher than all of

Table 2
Discriminant validity – Fornell – Larcker criterion.

Construct	ATT	INT	NEP	PC	PEOU	PU	SI	SK	ST
ATT	**0/894**[a]								
INT	0/462	**0/853**							
NEP	0/411	0/402	**0/819**						
PC	0/349	0/340	0/277	**0/938**					
PEOU	0/454	0/760	0/379	0/335	**0/854**				
PU	0/610	0/557	0/441	0/339	0/533	**0/770**			
SI	0/400	0/434	0/478	0/397	0/428	0/472	**0/856**		
SK	0/130	0/523	0/149	0/068	0/335	0/222	0/352	**0/896**	
ST	0/259	0/468	0/412	0/151	0/458	0/396	0/521	0/256	**0/887**

Notes: [a] The bold values in the above matrix are the squared correlations between the latent constructs, and diagonal are AVEs; acronyms: PC: Perceived Cost; SK: Subjective knowledge; ST: Social trust; PU: Perceived usefulness; ATT: Attitude; NEP: New Ecological Paradigm; IN: Intention; SI: Social influence).

its cross-loadings with other constructs. The results, thus, indicate that there is discriminant validity between all the constructs based on Fornell– Larcker criterion and cross-loadings criterion.

4.2. Structural model

To test the hypotheses of this study, we deployed the SEM approach. Table 5 presents the summary of the hypotheses testing.

Additionally, the Heterotrait-Monotrait Ratio (HTMT) was used to confirm DV (Henseler, Ringle, & Sarstedt, 2015). An HTMT value above 0.90 suggests a lack of DV (Hair et al., 2017). A more conservative cut-off value for HTMT is 0.85 (Henseler et al., 2015). The results of the HTMT criterion were established at HTMT0.90, indicating that as illustrated in Table 4, the present study did not violate the assumptions of DV Except (PEOU) which its HTMT criterion value is above 0.9. Therefore, the results of the overall measurement model demonstrate adequate internal consistency reliability, CV, and DV.

Table 4
Heterotrait-Monotrait Ratio (HTMT).

Construct	ATT	INT	NEP	PC	PEOU	PU	SI	SK
INT	0/548							
NEP	0/444	0/454						
PC	0/390	0/392	0/301					
PEOU	0/535	0/936	0/431	0/382				
PU	0/740	0/706	0/526	0/401	0/674			
SI	0/471	0/521	0/552	0/456	0/517	0/585		
SK	0/144	0/607	0/155	0/072	0/388	0/264	0/395	
ST	0/287	0/552	0/444	0/216	0/537	0/474	0/597	0/296

The primary criterion for conceptual model evolution is R^2, which represents the amount of explained variance of each endogenous latent variable (Hair, Sarstedt, Ringle, & Mena, 2012). R^2 values of 0.75, 0.50 or 0.25 for the endogenous latent construct, as a rule of thumb, are

Table 3
Discriminant validity – loading and cross-loading criterion.

	ATT	INT	NEP	PC	PEOU	PU	SI	SK	ST
AT1	**0/898**	0/401	0/374	0/234	0/394	0/527	0/345	0/138	0/207
AT2	**0/874**	0/440	0/383	0/299	0/458	0/575	0/350	0/112	0/265
AT3	**0/908**	0/394	0/342	0/405	0/357	0/527	0/378	0/098	0/219
IN1	0/384	**0/774**	0/319	0/350	0/590	0/441	0/348	0/402	0/352
IN2	0/371	**0/865**	0/334	0/152	0/646	0/473	0/352	0/510	0/415
IN3	0/427	**0/915**	0/375	0/370	0/703	0/509	0/408	0/426	0/427
NEP1	0/311	0/355	**0/824**	0/225	0/312	0/401	0/408	0/088	0/394
NEP2	0/248	0/224	**0/805**	0/214	0/242	0/322	0/372	0/079	0/300
NEP3	0/401	0/352	**0/843**	0/213	0/332	0/326	0/371	0/158	0/305
NEP4	0/310	0/380	**0/803**	0/256	0/333	0/430	0/426	0/107	0/403
NEP5	0/252	0/237	**0/799**	0/229	0/252	0/333	0/390	0/093	0/318
NEP6	0/431	0/367	**0/838**	0/228	0/348	0/348	0/384	0/174	0/304
PC1	0/332	0/300	0/240	**0/915**	0/289	0/349	0/356	0/061	0/117
PC2	0/304	0/348	0/283	**0/958**	0/353	0/288	0/378	0/079	0/161
PC3	0/351	0/306	0/255	**0/939**	0/295	0/322	0/382	0/048	0/145
PEOU3	0/372	0/665	0/317	0/254	**0/814**	0/446	0/335	0/304	0/398
POUE1	0/394	0/632	0/322	0/286	**0/865**	0/443	0/391	0/331	0/350
POUE2	0/396	0/651	0/332	0/316	**0/884**	0/478	0/370	0/227	0/427
PU1	0/449	0/386	0/361	0/157	0/393	**0/722**	0/288	0/175	0/333
PU2	0/593	0/358	0/284	0/286	0/411	**0/770**	0/340	0/154	0/248
PU3	0/449	0/496	0/354	0/270	0/397	**0/828**	0/339	0/192	0/289
PU4	0/382	0/475	0/362	0/325	0/441	**0/757**	0/486	0/165	0/355
si1	0/371	0/393	0/464	0/320	0/385	0/438	**0/835**	0/296	0/505
si2	0/308	0/267	0/356	0/344	0/298	0/316	**0/821**	0/215	0/364
si3	0/344	0/431	0/399	0/360	0/403	0/439	**0/910**	0/374	0/453
sk1	0/156	0/459	0/155	0/059	0/357	0/221	0/324	**0/817**	0/215
sk2	0/111	0/484	0/151	0/071	0/297	0/211	0/325	**0/939**	0/244
sk3	0/123	0/467	0/132	0/081	0/292	0/194	0/374	**0/925**	0/208
sk4	0/072	0/461	0/091	0/028	0/249	0/166	0/232	**0/897**	0/251
st1	0/141	0/344	0/201	−0/090	0/310	0/242	0/312	0/277	**0/794**
st2	0/253	0/428	0/381	0/199	0/432	0/345	0/523	0/202	**0/943**
st3	0/273	0/458	0/468	0/229	0/455	0/436	0/517	0/220	**0/916**

Notes: bold values are loadings for items, which are above the recommended value of 0.5; acronyms: PC: Perceived Cost; SK: Subjective knowledge; ST: Social trust; PU: Perceived usefulness; ATT: Attitude; NEP: New Ecological Paradigm; IN: Intention; SI: Social influence.

Table 5
Hypothesis testing.

Path	Path coefficient	t-value	P Value	Decision
ATT -> INT	0.054	2.850[**]	0.005	Supported
NEP -> ATT	0.056	2.204[*]	0.028	Supported
NEP -> INT	0.045	1.887	0.060	Rejected
PC -> INT	0.043	3.730[**]	0.000	Supported
PEOU -> ATT	0.074	2.098	0.036	Supported
PEOU -> PU	0.063	6.938[**]	0.000	Supported
PU -> ATT	0.068	6.565[**]	0.000	Supported
PU -> INT	0.072	3.365[**]	0.001	Supported
SI -> ATT	0.065	1.375	0.170	Rejected
SI -> INT	0.059	1.812	0.071	Rejected
SI -> PEOU	0.061	6.998[**]	0.000	Supported
SK -> ATT	0.050	1.423	0.155	Rejected
SK -> INT	0.055	7.368[**]	0.000	Supported
SK -> PU	0.061	0.446	0.656	Rejected
ST -> INT	0.049	4.577[**]	0.000	Supported
ST -> PU	0.066	2.864[**]	0.004	Supported

Note: Critical t-values for two-tailed test: [*]1.96and [**]2.58.

Table 6
Results of R^2 and Q2 values*.

Endogenous latent variables	R2	Q2
ATT	0/420	0.315
INT	0/566	0.388
PEOU	0/184	0.126
PU	0/314	0.171

Notes: *Q^2 value = 0.02 = small; 0.15 = medium; 0.35 = large.

considered as substantial, moderate or weak, respectively (Hair et al., 2011). Table 6 shows that the R^2 for the entire model is 0/566, which presents a reasonable explanation of the model. In addition to evaluating the magnitude of the R^2 values as a criterion of predictive accuracy, researchers should also examine the Q^2 value, Which is an indicator of the model's predictive relevance. When blindfolding is run for all endogenous latent constructs in the model, they all have Q^2 values considerably above zero. Table 6 shows that all Q^2 values are considerably above zero, thus providing support for predictive relevance for the four endogenous constructs (Hair et al., 2011). Table 6 shows the results of R^2 and Q^2 values

5. Conclusion and discussion

The purpose of this study was to examine the effect of psychological factors on the intention to adopt GBTs in Iran. Data were obtained from green experts in Tehran. The theoretical framework of Technology Acceptance Model (TAM) was adopted using five factors, including subjective knowledge, social trust, social influence, perceived cost, and environmental attitude.

In this study, GBTs are technologies used in the design and implementation of GBs to achieve sustainability. Several examples of GBTs include green roofs, solar energy, precast concrete, heating-cooling ventilation, energy-efficient windows, and so forth. In this vein, the Iranian government has recently attempted to launch GBTs programs in order to motivate developers to adopt green technologies in buildings.

Overall, results indicated that elven hypotheses out of sixteen hypotheses, were confirmed. However, the effects of environmental attitude on intention, social influence on intention and attitude, and subjective knowledge on perceived ease of use and attitude were found to exert no significant influence.

Prior researches have shown that subjective knowledge influences individuals' concern about environmental protection and sustainability. In the GB context, research has also highlighted the crucial role of knowledge and public awareness of concepts such as GBs and GBTs in adopting green technologies (Niroumand, Zain, & Jamil, 2013;

Udawatta, Zuo, Chiveralls, & Zillante, 2015)

In the present study, the first hypothesis (H1) which suggested the direct influence of subjective knowledge on intention to adopt, was confirmed (β = 0.055, t = 7.365),. This finding is in line with findings of Liu and Lin (2016); Juan, Hsu, and Xie, (2017); Lu, Wu, Chang, and Li, (2017); Huo, Ann, and Wu, (2018); Liu et al. (2018), and Darko and Chan (2017).

Contrary to the findings of Liu et al. (2018), the effect of subjective knowledge on attitude and perceived usefulness (H2 and H3 hypotheses) was not confirmed (β = 0.061, t = 0.446; β = 0.050, t = 1.423). However, the inclusion of this factor to the TAM model might increase its predictive power to understand the process of green technology adoption. It is thus clear that policymakers should attempt to design programs and strategies promoting knowledge and awareness of GBTs acceptance among individuals.

Social trust is another construct examined in past research on GB. According to Liu et al. (2018), social trust in responsible organizations which provide green technologies, can influence the intention to adopt technologies. Liu et al. (2018), Point out that this is particularly useful in the initial stages when the acceptable risk is high for technology adopters. Results showed that the fourth and fifth hypotheses (H4 and H5) were confirmed(β = 0.049, t = 4.577; β = 0.066, t = 2.864), indicating the positive influence of social trust on intention and perceived usefulness. These findings are consistent with Zhao et al. (2015); Zhang, Shen, and Wu, (2011); Mulligan, Mollaoglu-Korkmaz, Cotner, and Goldsberry, (2014); Serpell, Kort, and Vera, (2013); and Liu et al. (2018). It is therefore suggested that researchers reconsider the role of social trust in models of green technology since this construct can increase the explanatory power of TAM. The image and credibility of GB companies and GB adopters should also be a concern of policymakers.

The proposed model in this study indicated that environmental attitude could explain the adoption of green technologies in Iran. Testing the seventh and eight hypotheses (H7 and H8), it was found that environmental attitude directly influenced the general attitude towards GBs and the intention to adopt green technologies(β = 0.056, t = 2.204; β = 0.045, t = 1.887). This finding is by Juan et al. (2017), Liu et al. (2018). Hence, it is suggested that future researchers reconsider the role of environmental attitude in models of green technology since this construct can increase the explanatory power of TAM. It is safe to conclude that promoting strategies, related to environmental protection, can affect the attitude and intention to adopt GBs, and need to be included in large-scale GB-based plans.

Although behavioral models such as the theory of planned behavior (TPB) and complementary technology acceptance models such as TAM2 and the unified theory of acceptance and use of technology (UTAUT) often emphasize the influence of social influence on acceptance behavior, research has partially examined the role of social influence as it is connected with governmental regulations and laws. Zhao et al. and Darko et al. note that research into the social influence has failed to explore the role of family members, friends, and peers in accepting GBTs. By adding this construct (i.e., social construct), the present study attempted to fill this gap. Testing the hypotheses (H13, H14, and H15), results demonstrated that social influence significantly influenced the perceived ease of use(β = 0.061, t = 6.998). Also, social influence was found to exert no significant influence on the attitude and intention to use(β = 0.065, t = 1.375). The significant influence of social influence on the adoption of GBTs has been highlighted in Juan & Hsu & Xie's (Juan et al., 2017) study. It is clear that if members of reference groups emphasize and support the adoption of technologies, other individuals may experience the greater perceived ease of technology use.

The perceived cost was the last construct added to the model to increase its explanatory power. Since previous research has emphasized cost-benefit analysis (CBA) prior to adopting GBTs, the inclusion of the perceived cost of the proposed model was deemed necessary. Since the hypothesis (H16) was confirmed(β = 0.043, t = 3.730), it might be argued that perceived cost, as a predictor of intention to adopt, need to

be added to the TAM. This finding is supported by Reed and Wilkinson (2005); Chan, Qian, and Lam, (2009); Windapo (2014); DuBose, Bosch, and Pearce, (2007); Ahn, Pearce, Wang, and Wang, (2013); Manoliadis, Tsolas, and Nakou, (2006); Niroumand et al. (2013). Therefore, it can be stated that advocacy campaigns which promote technology use should emphasize the benefits of green technologies than cost so that the adoption and intention to use technologies become a growing interest among people.

The perceived usefulness of GBTs indicated the extent to which the participants perceived these technologies as effective in reaching their desired goals. The results confirmed the influence of the perceived usefulness of GBTs on the attitude and intention (both H9 and H10 were confirmed) ($\beta = 0.068$, t = 6.565; $\beta = 0.074$, t = 2.098). These findings are consistent with Bronfman, Jiménez, Arévalo, and Cifuentes, (2012); Visschers and Siegrist (2012); and Liu et al. (2018). In fact, the higher perceived usefulness of technologies results in the more attractiveness of adoption. Accordingly, it is necessary to design programs (e.g., through advertising, media, etc.) to raise awareness of the general public awareness of GBTs. These programs must adopt policies that clearly outline the impact of technologies and their benefits to their audiences.

The perceived ease of GBTs indicated the extent to which the participants perceived the use of technologies as easy. Examining the relevant hypotheses (H11 and H12), it was found that perceived ease significantly influenced attitude and perceived usefulness($\beta = 0.063$, t = 6.938; $\beta = 0.074$, t = 2.098). These findings are consistent with Chung et al. (2010), and Park (2010). In addition, the influence of attitude on intention was confirmed (H6) ($\beta = 0.054$, t = 2.850), and this finding is also supported by Davis et al. (1989); Gefen et al. (2003); Liu et al. (2016), and Liu et al. (2018).

6. Theoretical and practical implications

Considering the unstable environmental conditions in Tehran (the capital of Iran), Tehran municipality and the Environmental Management Association made initial efforts to develop GB plans and conducted social campaigns for GBTs acceptance. However, due to a lack of strategic planning, lack of empirical research, and lack of government budget, these efforts soon failed. Accordingly, if there were further government-based initiatives and academic support, the efforts would have considerable effects on the reduction of environmental problems in the city.

With regard to the gap in past research and executive acceptance of GBTs in Iran, the current research drew on psychological and social factors to provide a powerful model for identifying the intention to adopt GBTs in the Iranian context. The results of this study provide a valuable reference for policymakers and stakeholders actively involved in GBs.

Since the results of the present study highlight the significance of subjective knowledge in the intention to adopt GBTs, it is suggested that in micro – and macro planning, a range of educational and communication strategies need to be employed to promote individuals' knowledge and attitudes towards GBTs.

The deployment of such strategies might result in the launch of Internet websites, e-newsletters, Telegram channels, Instagram pages, workshops, classes, seminars, and even academic courses on GBTs. On the one hand, due to high energy consumption and severe droughts through the last decades in Iran, the implementation of these strategies, though in the forms of public-based incentives, governmental motivations, and organizational support are likely to be effective.

On the other hand, considering the significant effect of social trust on perceived ease and intention to use, special emphasis should be placed on social trust in policymaking. The development of social trust in communication and interpersonal relationships helps negotiate knowledge and information sharing in a strategic manner. This requires the existence of shared views and goals, cultural adaptation, and social

harmony. Consequently, the creation of a favorable atmosphere improves the negotiation of ideas, and enhances mutual understanding among individuals. Such an atmosphere improves the clarity of the relationship between the agent and recipient of subjective knowledge. The subjective knowledge is more readily transmitted when the parties know precisely their goals. In fact, it might be argued that the implementation and operationalization of GBs plans take effect when plans are organized in a bottom-up manner, and stakeholders' participation throughout whole stages of the building development is taken into account. Bottom-up programs potentially help increase individuals' awareness of GBTs and GBTs usage. Also, these programs might result in an intention to adopt and use GBTs. Relatedly, active companies in the construction industry should care that their popularity among customers is a crucial factor affecting the adoption of GBTs.

The observed effect of environmental attitudes on the adoption of GBTs indicates that promoting pro-environmental products as well as supporting GB plans can create a strong operational synergy for the initial processes of social acceptance of green technologies. It thus seems important for active companies choosing environment-friendly customers since customers' environmental attitudes might influence not only public awareness of GBTs but also provide beneficial insights into how building companies urge the adoption of GBTs.

Considering the positive effect of social influence on perceived ease of using GBTS in this study, policy makers should consider the role of reference groups and the social environment through which they may encourage individuals and extend the influence of technology among people through systematic planning. This results in an understanding that using technologies is easy and effortless.

According to the results of the study, another factor affecting the intention to adopt was the perceived cost. Policy makers should note that financial incentives and government-based motivations and regulations are undoubtedly crucial factors in the implementation and adoption of GBTs programs. In such programs, individuals first estimate the costs and then consider the adoption of GBTs. Hence, financial incentives, awareness raising tax reduction, and governmental regulations and policies offer long-term benefits to developers, accelerating the process of GBTs adoption.

Regarding the importance of perceived usefulness, perceived ease of use, and attitude in adopting GBTs, programs should be designed in such as to enhance individuals' ability to use technologies, to understand the usefulness of technologies, and consequently to develop positive attitudes towards technologies. Two things are noteworthy. First, the selection of appropriate technologies is a neglected issue. Accordingly, GBTs-focused programs can help guide individuals in choosing energy-efficient and green technologies in their buildings. Second, test cases of GBs can be an appropriate means in promoting individuals' understanding of perceived usefulness, perceived ease of use, and attitude towards such buildings. Since there is still a lack of such test cases to visit in the research context (i.e., Tehran), planning pilot GB projects is strongly recommended.

Finally, in order to avoid failure of programs, responsible organizations should design comprehensive GBs programs and raise developers and customers' awareness of the benefits of adopting GBTs. Therefore, the preliminary step is to establish powerful organizations capable of running GBTs programs. Such organizations must be supported financially and legally by the government so that they can exercise influence in reducing environmental problems and moving towards sustainability.

7. Limitations and directions for future research

The study has some limitations worth mentioning. First, the participants were employees of Tehran province green spots only. This limits the generalization of the findings. Future studies are recommended to adopt a larger sample from diverse populations. Second, the proposed research model was context-specific, and future research can test it

within diverse contexts. Finally, the study used a single instrument (i.e., questionnaire) to collect the data, and future research should use longitudinal data to assess the proposed model. It is also noteworthy that the study did not delve into GBs deeply in the Iranian setting because of reasons, including culturalization, financial issues, lack of knowledge, etc. The adoption of GBs and GBTs seems to be a gradual process and future research can capture the opportunity to explore the context of Iran.

Appendix A. The Questionnaire

Subjective Knowledge
    SK1: I know pretty much about GBTs.
    SK2: I know how to judge the quality of GBTs.
    SK3: I know why we need to develop GBTs.
    SK4: I know the advantages of GBTS over conventional buildings.
Social Trust in responsible organizations
    ST1. I know Technology-driven organizations will always try to help me out if I get into difficulties.
    ST2. I can always trust Technology-driven organizations to lend me a hand if I need it.
    ST3. I can always rely on Technology-driven organizations to make my usage easier.
Social influence
    SI1: People who are important to me think that I should use GBTs.
    SI2: People who influence my behavior encourage me to use GBTs.
    SI3: In general, Eco-friendly organizations have supported the use of GBTs.
Perceived cost
    PC1: The fee for paying for GBTs is too high.
    PC2: The fee for installing GBTs is too high.
    PC3: Overall, I find it risky to accept GBTs.
Environmental attitudes
    NEP1: We are approaching the limit of the number of people the earth can support.
    NEP2: The earth is like a spaceship with very limited room and resources.
    NEP3: When humans interfere with nature it often produces disastrous consequences.
    NEP4: The balance of nature is very delicate and easily upset.
    NEP5: Humans are severely abusing the environment.
    NEP6: If things continue on their present course, we will soon experience a major ecological catastrophe.
Attitude
    AT1: I believe that using GBTs is a good idea.
    AT2: I believe that using GBTs is advisable.
    AT3: I support the development of GBTs.
Perceived usefulness
    PU1: GBTs are useful to conserve land resources, building materials, and other resources.
    PU2: GBTs are useful to protect the environment and reducing pollution.
    PU3: GBTs are useful to reduce household expenditures such as water and electricity charges.
    PU4: GBTs are useful to improve the residents' living comfort at home.
Perceived ease of use
    PEOU1: Learning to use GBTs is easy.
    PEOU2: It is easy to become proficient in using GBTs.
    PEOU3: The interaction with GBTs is clear and understandable.
Intention to use0
    IN1: I would like to buy GLRBs.
    IN2: I would like to use GLRBs.
    IN3: I would like to recommend GLRBs to my family and friends.

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